

**Failure Analysis of Chart MVE 808AF-GB Cryopreservation Tank  
Serial Number CAB2112020013**

**Pacific Fertility Center Litigation**

**United States District Court  
Northern District of California  
San Francisco Division**

**Case No. 3:18-cv-01586-JSC**

**Date of Incident: Sunday, March 4, 2018**

**Location of Incident: Pacific Fertility Center  
55 Francisco Street, Suite 500, San Francisco, California 94133**

**REDACTED - FILE UNDER SEAL**

**Report prepared by:  
Anand David Kasbekar, Ph.D.**

**File No. 1780**

**October 15, 2019**

## **Background**

[REDACTED]

[REDACTED]

[REDACTED]<sup>1</sup> The PFC laboratory is operated by Prelude Fertility, Inc. and its subsidiary Pacific MSO LLC. Prelude runs a network of fertility clinics and embryo and egg storage facilities throughout the United States. The subject tank known as “Tank #4” [REDACTED],<sup>2</sup> and according to Chart [REDACTED].<sup>3</sup> Tank #4 was being used to store vitrified eggs and embryos from [REDACTED]

[REDACTED].<sup>4</sup> The majority of the affected PFC IVF clients thus had all their eggs and embryos stored only in Tank #4.

[REDACTED]

---

<sup>1</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001986; Deposition of Alden Romney 94:17-95:9.

<sup>2</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001986.

<sup>3</sup> CHART001432 (Intended Use Characteristics).

<sup>4</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001987.

[REDACTED]

[REDACTED]

[REDACTED]<sup>5</sup> [REDACTED]

[REDACTED]

[REDACTED]<sup>6</sup> [REDACTED]

[REDACTED]

[REDACTED]<sup>7</sup> [REDACTED]

[REDACTED]<sup>8</sup> [REDACTED]

[REDACTED]<sup>9</sup> [REDACTED]

[REDACTED]

[REDACTED]<sup>10</sup> [REDACTED]

[REDACTED]

[REDACTED]<sup>11</sup> [REDACTED]

[REDACTED]

[REDACTED]<sup>12</sup> [REDACTED]

[REDACTED]

[REDACTED]<sup>13</sup> [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]<sup>14,15,16</sup>

---

<sup>5</sup> Deposition of Joseph Conaghan 40:15-25.

<sup>6</sup> Deposition of Joseph Conaghan 43:14-15, 101:12-21.

<sup>7</sup> Deposition of Joseph Conaghan 40:19-20; 101:22-102:1, 105:13-18.

<sup>8</sup> Deposition of Joseph Conaghan 151:20-21.

<sup>9</sup> Deposition of Joseph Conaghan 100:25-101:6.

<sup>10</sup> Deposition of Joseph Conaghan 115:18-116:5.

<sup>11</sup> Deposition of Joseph Conaghan 136:22-25; 137:18-21.

<sup>12</sup> Deposition of Joseph Conaghan 112:6-12.

<sup>13</sup> Deposition of Joseph Conaghan 112:13-113:8.

<sup>14</sup> Deposition of Joseph Conaghan 114:10-20.

<sup>15</sup> Deposition of Joseph Conaghan 117:13-23.

<sup>16</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001994-1997; Conaghan Depo 41:19-24.

[REDACTED]

[REDACTED]

As a result of the failure of the subject tank, stored eggs and embryos were more likely than not exposed to elevated temperatures. The tank failure and resulting deformation may have also delayed recovery efforts. [REDACTED]

[REDACTED]<sup>17</sup> At some point after the incident, the controller, which includes an auto-fill mechanism, was removed from Tank #4. Both the tank and controller were transported from the fertility clinic to Exponent's Menlo Park Facility on March 8, 2018 (see Figure 4).

---

<sup>17</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001986.



**Figure 4: Subject Chart MVE TEC 3000 Controller after removal and transport to Exponent.**

The original installation of the subject tank included the previously discussed automated controller system and an integrated alarm system designed to maintain and provide 24x7 monitoring of tank temperature and liquid nitrogen levels, and alert staff by telephone in the event of a problem (see Figure 5). PFC indicated that sensors for the monitoring system “are connected to a telephone alarm system that will alert staff to an alarm condition outside of normal working hours. . . . The alarm system is tested weekly and continues to run on battery power in the event of a power failure. The alarm system can also be checked remotely.”<sup>18</sup> When a tank alarm goes off, the on-call embryologist is supposed to arrive within 30 minutes regardless of time of day and must conduct a physical inspection of the tank before the alarm can be turned off.<sup>19</sup> [REDACTED]

<sup>18</sup> Sperm and Embryo Freezing, Pacific Fertility Center, [www.pacificfertilitycenter.com/treatmentcare/sperm-and-embryo-freezing](http://www.pacificfertilitycenter.com/treatmentcare/sperm-and-embryo-freezing) 9-24-2019

<sup>19</sup> Id.

<sup>20</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001986.

[REDACTED] 21,22 [REDACTED]  
[REDACTED]  
[REDACTED] [REDACTED]  
[REDACTED]  
[REDACTED] 24



[REDACTED]

[REDACTED] 25 [REDACTED]  
[REDACTED]  
[REDACTED] 26

[REDACTED]  
[REDACTED] 27 [REDACTED]  
[REDACTED]  
[REDACTED] 28

Although this notice does not include the MVE  
808 tank, the recall notice emphasizes the need to immediately remove units from service due to

---

<sup>21</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001986.

<sup>22</sup> Deposition of Joseph Conaghan 72:13-16.

<sup>23</sup> Deposition of Joseph Conaghan 187:18-24.

<sup>24</sup> Id.

<sup>25</sup> Id.

<sup>26</sup> Deposition of Joseph Conaghan 89:22-90:4 and 93:11-19

<sup>27</sup> MSO024140-41

<sup>28</sup> MSO001314 (4/23/2018 Chart Recall Notice).

the potential for a sudden vacuum seal leak or failure. [REDACTED]

[REDACTED]

[REDACTED]<sup>29</sup>

In early April of 2018, Plaintiffs' counsel representing individuals whose material was stored in Tank #4 requested my assistance in evaluating the current condition of the subject Chart Cryopreservation Tank and investigating the cause of the tank failure. This report outlines my efforts to date along with my preliminary findings and opinions. This investigation is ongoing, and these findings and opinions are subject to change.

### **Materials Reviewed**

Reviewed file materials include the following:

1. 2018-05-30 Complaint
2. 2018-09-14 & 18 Protective Orders
3. 2019-09-10 Deposition Transcript of Pacific MSO and A. Romney
4. 2019-10-09 Deposition Transcript of Pacific MSO and J. Conaghan
5. MVE Cryopreservation for Life Science Catalog – Brochure
6. Chart 000001-000126 (Chart Tank Drawings and Specifications)
7. CHART000058 – 60 (2012-01-24 Tank QC and Shipping)
8. CHART000918-1050 (2010-08 Tank and TEC 3000 Manual)
9. CHART001432 (2006-03-01 DFMECA - CRYO-RA-001 L)
10. CHART005674-005675 (Risk Assessment)
11. CHART008455 (Emails RE-MVE Controller Problems in Europe)
12. CHART009518 (Catalog ML-CRYO0009 H 13b)
13. CHART010131 (2018-03-15 - Tech3000 Improvement Project 3\_15\_18)
14. CHART025664 (No Back EMF Protection)

---

<sup>29</sup> CHART008455, CHART010131, CHART025664, and EXTRON-002060

15. CHART026003 (2015 Field Service Email)
16. CHART031908-031909 (TEC 3000 Manual Event Codes User Defined Alarms)
17. CHART034331 (2015 Field Service Email)
18. EXTRON-002060
19. MSO001314 (2018-04-23 Chart Recall Notice)
20. MSO001982-2220 (2018-03-23 PFC Response to CAP Request and Exhibits 1-12)
21. MSO012832 (2018-03-13 Letter from Joe Conaghan to CA Dept of Health)
22. MSO012835 (2018-03-13 Letter from Joe Conaghan to College of American Pathologists)
23. MSO021089-21250 MVE TEC 3000 Tech Manual (Rev G)
24. MSO024140-41
25. PRELUDE 002283-002285 (2018-03-08 Email Correspondence from Yelena Pasma to Suzan Hertzberg)
26. MSO023987 (Photograph of Exemplar Tank Interior with Rack and Vials in Place)

In addition to reviewing the above materials, I have also had the opportunity to conduct an inspection of the Pacific Fertility Center, the subject Tank #4, and the associated controller. The tank inspection and evaluation of the controller are ongoing.

### **Description of Work Performed**

I conducted an inspection of the Pacific Fertility Center located at 55 Francisco Street in San Francisco, CA on September 24, 2018. This inspection consisted of visually examining, photographing, and videotaping the laboratory area where the Chart model MVE 808AF-GB Cryopreservation Tank had been located at the time of the incident on March 4, 2018. The subject tank itself was no longer at PFC and was inspected at the Menlo Park offices of Exponent on September 25, 2018. This first tank inspection was limited to visually examining and photographing the tank, tank lid, the previously removed MVE TEC 3000 controller, and the previously disassembled vacuum port plug assembly. The interior of the tank bottom was not

accessible at the time of this inspection. The underside of the tank also could not be inspected, and the interior tank bottom could not be examined without destructive removal of the tank's false bottom. Although no testing was done during this tank inspection, Defendants' consultant, Exponent, had previously conducted leak testing, digitization, and cleaning of the subject tank and tank cover.

A second follow-up inspection of the subject tank took place at Exponent a year later on September 30, and October 1, 2019. This second inspection involved additional photographic documentation of the subject tank, lid, vacuum port components, and associated controller. The tank was suspended by its handles in order to facilitate examination of the underside and vacuum port. Leak testing was then conducted in a reportedly similar manner to the leak testing that was done by Exponent prior to the September 25, 2018 joint inspection. A helium tank was plumbed to a modified natural gas utility meter that was equipped with pressure gauges, a temperature gauge, an Elster dial gauge to track helium flow into the subject cryogenic tank's vacuum jacket, and a Dwyer Magnehelic differential pressure gauge to monitor helium pressure within the vacuum space. The target helium pressure was 20 inches of water and the helium was plumbed into the vacuum port of the subject tank using an expansion plug. An Agilent Technologies VARI-VSPD031 VS Portable Mass Spectrometer Helium Leak Detector equipped with a Power Probe Sniffer was used to probe for leaks in the vicinity of the welded seams, fittings, and other areas both on the tank interior and exterior. Indications of leakage were found along the lower welded seam on the inside tank wall of the vacuum jacket. The most significant helium readings were detected at and within several inches of the annular weld at the edge of the lower elbow for the interior LN<sub>2</sub> fill port. Swagelock Snoop® Liquid Leak Detector was utilized to visually check for leaks within the suspect areas that were located using the helium leak detector. A clear indication of leakage (formation of bubbles) was observed and centered along the lower circumference of the welded edge of the fill port (Figures 6-8). This location was directly above the edge of the false bottom (a.k.a. tank shelf) where it meets the interior tank wall.

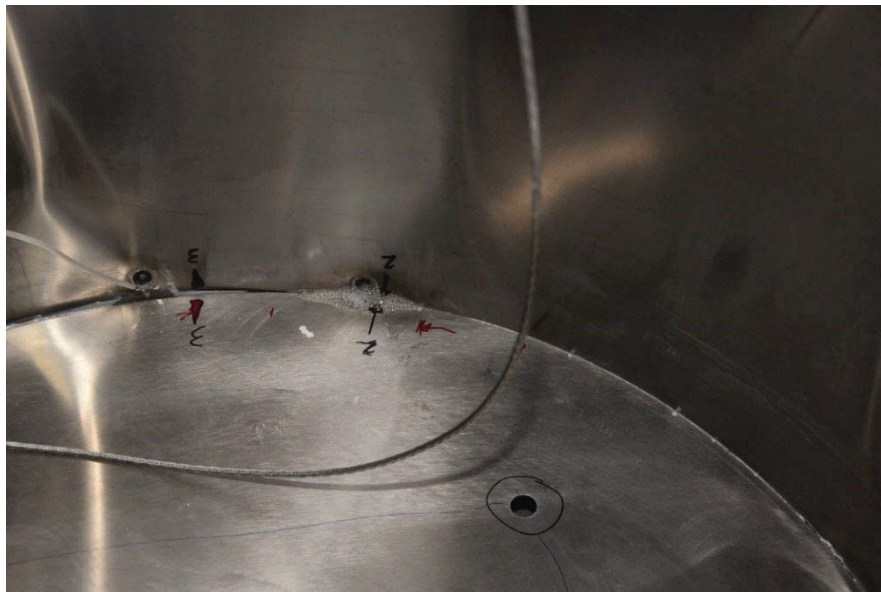
In order to gain access to the tank bottom and to further investigate the leak location, the false bottom was sectioned and removed by an Exponent representative (Figures 9-13). Sectioning was primarily accomplished using an angle grinder and abrasive cutting wheel. Care was taken not to cut or nick the interior tank wall with the cutting wheel. The thickness of the

removed false bottom measured approximately 0.11 inches

<sup>30</sup>

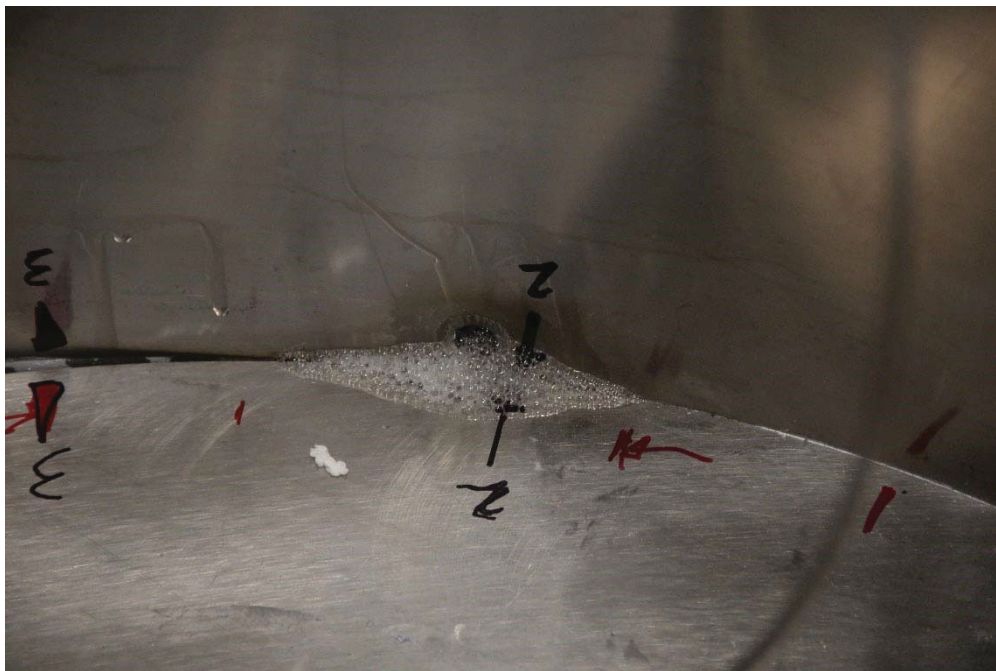


***Figure 6: Application of Swagelock Snoop® Liquid Leak Detector at the annular weld of the subject tank's interior fill port.***



***Figure 7: Positive leak site identified by bubbles in liquid leak detector at lower region of the annular weld of the subject tank's interior fill port.***

<sup>30</sup> CHART000073 (False Bottom Dwg A9570)



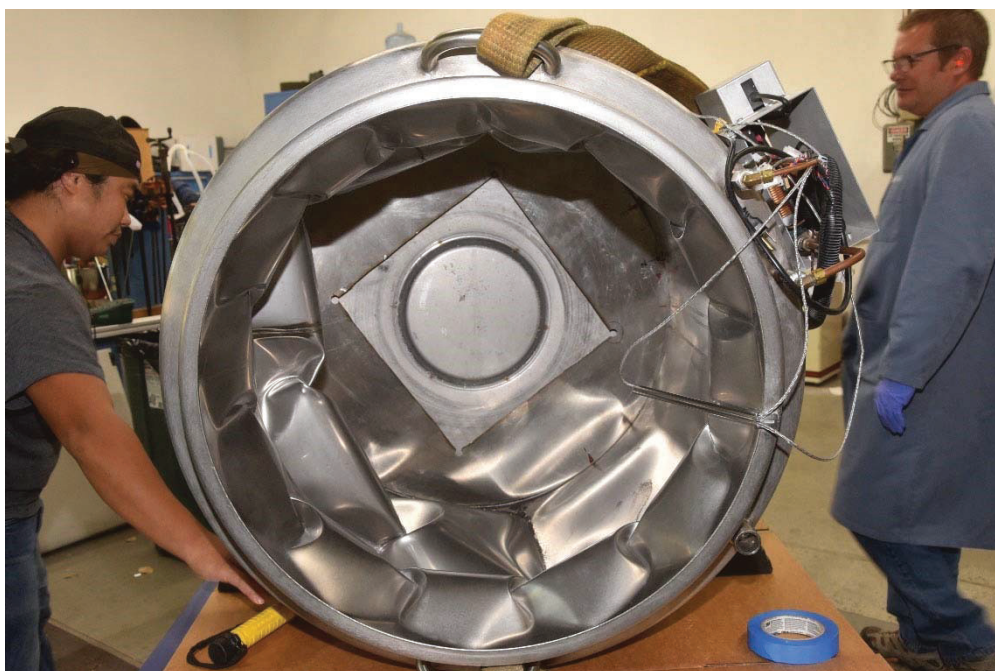
*Figure 8: Close-up of prior area shown in prior figure. Positive leak site identified by bubbles in liquid leak detector at lower region of the annular weld of the subject tank's interior fill port.*



*Figure 9: Sectioning of subject tank's false bottom using abrasive cutting wheel.*



*Figure 10: Sectioning of central region of the subject tank's false bottom.*



*Figure 11: Central square section removed from subject tank's false bottom revealing actual bottom of the tank.*



***Figure 12: Remainder of tank's false bottom removed revealing entire actual bottom of the subject tank.***



***Figure 13: Removed sections that comprise the subject tank's false bottom.***

During removal of the false bottom it became apparent that fragments of broken vials were beneath this panel. The fragments and debris found on the tank floor were collected and bagged (Figures 14-15). In addition, a white residue was visible below the lower seam and generally centered around the leveling port. Three scrapings were collected to preserve this residue for future analysis if warranted (Figures 16-17).

A Keyence VHX 2000 Digital Microscope fixed to a boom arm was used to more closely examine the leak area that was detected along the lower edge of the welded fill port. This microscope along with the use of a portable handheld microscope revealed a substantial crack in the weld of the fill port (Figures 18-20). This circumferential crack was clearly visible at about a 20X magnification between approximately the 4 o'clock and 8 o'clock positions. In order to further check for cracks and better evaluate the observed crack, non-destructive testing (NDT) was conducted using Magnaflux Spotcheck® liquid dye penetrant. The NDT confirmed the presence of the circumferential crack (Figures 21-22).



***Figure 14: Vial fragments and debris found on subject tank floor after sectioning and removal of false bottom.***



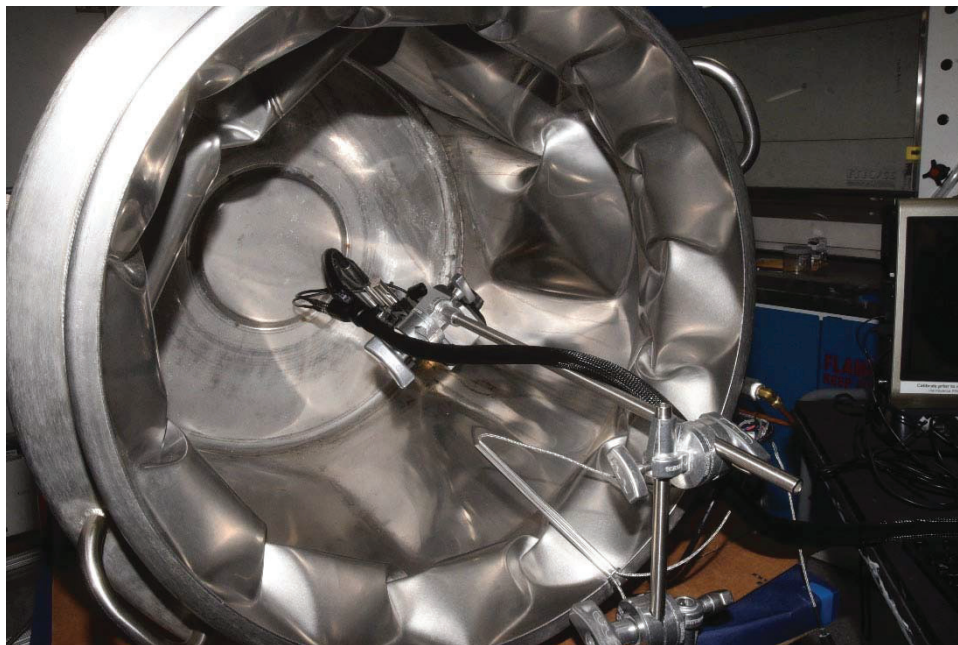
*Figure 15: Collected vial fragments and debris from subject tank floor.*



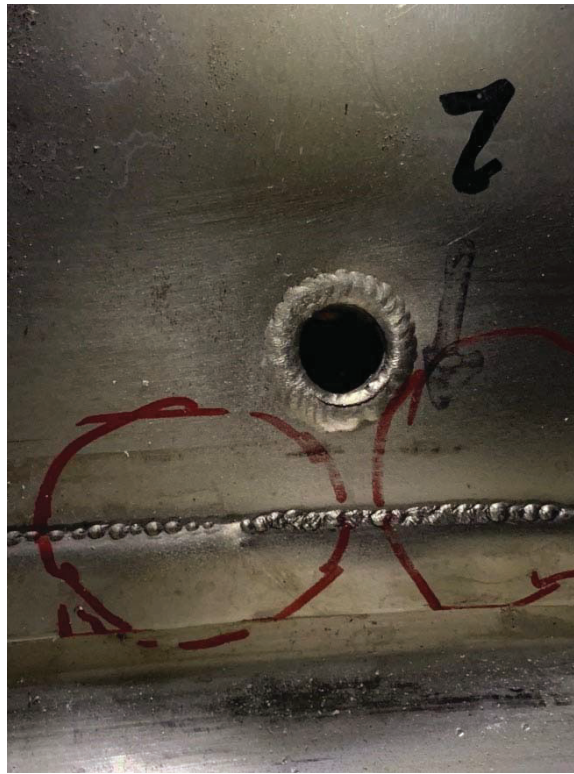
*Figure 16: White residue located below the lower seam weld of the subject tank in area of leveling port. Samples collected for potential future chemical analysis.*



*Figure 17: Close-up of white residue shown in previous figure.*



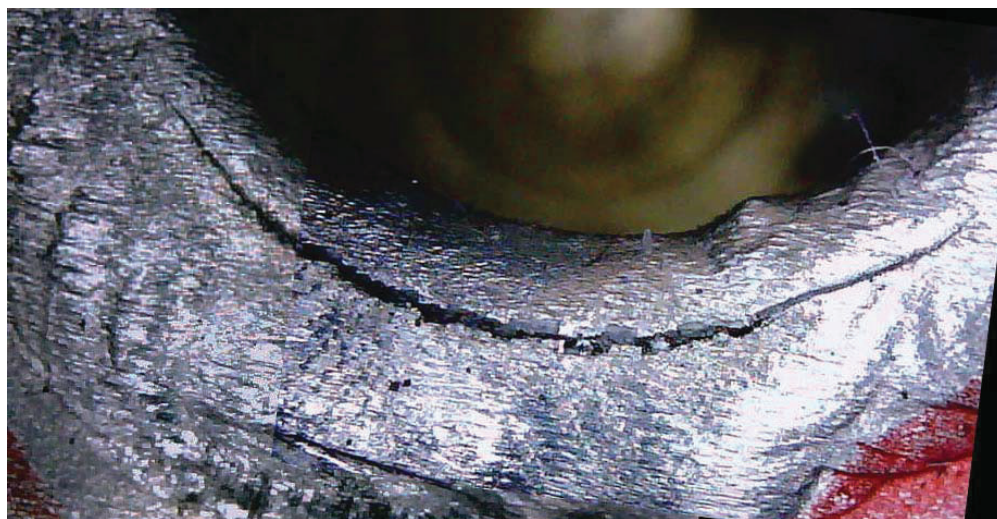
*Figure 18: Keyence Digital Microscope mounted to boom and used to evaluate weld areas in lower region of the subject tank.*



*Figure 19: Photograph of crack in annular fill port weld located above the lower seam weld.*



*Figure 20: Close-up of crack in annular weld of fill port shown in prior figure.*



***Figure 21: Handheld digital microscope image of crack in annular weld of fill port shown in prior figure.***



***Figure 22: Magnaflux Spotcheck liquid dye penetrant applied to lower seam weld and annular welds for the fill and level ports. Note that the annular weld for the fill port, which is the right most of the two ports, shows clear indication of cracking.***



***Figure 23: Close-up of annular weld for the fill port shown in previous figure. The red line between approximately the 4 o'clock and 8 o'clock positions is a clear indication of cracking.***

Additional areas were noted where the red dye penetrant was visible, but most of these regions appear to be associated with the tank seam geometry under which dye was likely trapped through capillary action. There were areas along the seam weld that were revealed by this NDT method and are suspect. However, it should be noted that these areas may be a result of weld geometry or incomplete cleaning of the red dye prior to applying the developer and may not be a true indication of additional cracking. More detailed evaluation of these areas is warranted in order to confirm the presence of lower interior seam weld cracks in these suspect regions.

The remainder of the October 1, 2019 tank inspection involved additional 3D scanning of the tank to capture the tank geometry after the false bottom was removed. This work was subcontracted to Scansite3D by Exponent. Scan site coated the tank exterior and interior using Helling 3D laser scanning spray, which is an alcohol based aerosolized talc. A Creaform hand-held scanner was used to digitize the tank and the scanning process reportedly required approximately 5-6 hours to complete.

**Analysis and Discussion**

The specifications for the MVE 808 tank indicate an estimated full tank capacity of 230 liters of LN<sub>2</sub>. [REDACTED]

[REDACTED]<sup>31</sup> [REDACTED]

[REDACTED]<sup>32</sup> [REDACTED]

[REDACTED]

[REDACTED]<sup>33</sup> [REDACTED]

[REDACTED]. Based on the MVE 808 specifications and the testing performed by Chart, less than about 8 liters of LN<sub>2</sub> should have evaporated during this time period. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]<sup>34</sup> [REDACTED]<sup>35, 36</sup>

If the tank vacuum jacket remained intact, then the LN<sub>2</sub> evaporation should have been insignificant. However, if a vacuum jacket breach occurred allowing LN<sub>2</sub> to enter the vacuum space then a significant decrease in the LN<sub>2</sub> the level would occur more rapidly than from normal evaporation.

**Summary of Findings and Opinions**

The following is a summary of my findings and opinions based upon my training, education, and experience, along with my review of the available materials as listed above, and preliminary limited inspection and evaluation of the subject Chart MVE 808AF-GB Cryopreservation Tank. It should be noted that metallurgical analysis and fractography of the failed weld has not yet been performed and at present, discovery is ongoing. This preliminary report has been prepared in conjunction with Plaintiffs' class certification motion; it and the following findings and opinions

---

<sup>31</sup> CHART000088 (MVE 808 Spec Dwg).

<sup>32</sup> CHART000058.

<sup>33</sup> Deposition of Alden Romney 103:14.

<sup>34</sup> MSO001982 (20180323 PFC Response to CAP Requests and Exhibits 1-12) at MSO001985 and MSO002046; CHART001038.

<sup>35</sup> Deposition of Joseph Conaghan 99:18-25.

<sup>36</sup> Deposition of Joseph Conaghan 105:25-106:21.

will be revised or amended as necessary should additional information become available or if additional work is warranted.

1. [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]<sup>37</sup>
2. Chart knew or should have known that its MVE Cryogenic freezer such as the subject MVE808 tank, are used primarily for highly sensitive biotech applications including biological storage of human eggs and embryos. [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]<sup>38</sup> [REDACTED]  
[REDACTED]  
[REDACTED]<sup>39</sup>
3. Based on the inspection of the subject failed tank to date and the available information, it appears that the cause of failure was more likely than not a breach in the interior wall of the tank. It is unlikely that this breach occurred after PFC staff removed the lid from the tank after discovering water under and around the tank on March 4, 2018. Work to date indicates that this breach originated within the circumferential weld that is intended to secure the lower elbow of the fill port to the interior tank wall. The cracked weld more likely than not allowed liquid nitrogen to enter the warmer and otherwise sealed vacuum space. The liquid nitrogen then would have flashed from its liquid state to a vapor state with a significant volume expansion which caused the vacuum jacket to become pressurized. The internal pressure that developed within the vacuum jacket resulted in deformation of the tank's interior wall. This deformation increased over a period of time after the tank lid was removed. The internal vacuum breach and the initial internal tank deformation were likely the cause of the tank lid being jammed.

<sup>37</sup> Deposition of Alden Romney 139:5-7.

<sup>38</sup> CHART016303 (Chart/MVE Cryobiological Training 2016) at CHART0016315

<sup>39</sup> Id.

4. [REDACTED]  
[REDACTED]  
[REDACTED]<sup>40,41,42</sup> [REDACTED]  
[REDACTED] There is no evidence that Chart issued a service bulletin or similar document to notify their clients and end users regarding the potential for controller malfunctions, the associated risks and how to prevent or minimize such risks.
5. The subject Chart tank should have been designed, fabricated and instrumented such that an internal catastrophic and undetected vacuum breach could not occur. While long term vacuum degradation can be detected, a catastrophic breach will result in a more rapid loss of cooling, the introduction of and flashing of liquid nitrogen within the sealed vacuum space, deformation of the tank, and difficulty in accessing the tank contents.
6. The documents available to date lack adequate instructions to alert the user of the Chart Cryopreservation tank to the potential for a loss of vacuum and catastrophic failure of the tank. Chart knew or should have known that these tanks were being used for egg and embryo storage and could have anticipated failure modes such as a malfunctioning controller and/or a loss of vacuum and provided appropriate warnings and instructions regarding proper responses to such failures or indications of impending failures. [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]<sup>43</sup>
7. While a sudden internal vacuum breach should not have occurred, the tank exterior should be equipped with a controlled pressure relief port or rupture disc to mitigate tank deformation and protect the structural integrity of the tank.
8. Based on the inspection of the subject tank to date along with the currently available information, the vacuum breach most likely occurred after the subject tank was filled on Saturday March 3, 2018 and closer to the time that the laboratory staff discovered a

---

<sup>40</sup> CHART026003.

<sup>41</sup> CHART034331.

<sup>42</sup> Deposition of Joseph Conaghan 72:5-12.

<sup>43</sup> CHART01432 (DFMECA)

problem on Sunday March 4, 2018 at about 12:30 p.m. [REDACTED]  
[REDACTED]  
[REDACTED]

[REDACTED]<sup>44</sup> This opinion may change or be revised pending additional discovery as well as further analysis of the tank including metallurgical analysis and fractography of the failed weld and any other through wall cracks that are located inside the subject tank.

In the event this matter continues to move forward, I may conduct additional testing, analyses, and/or prepare physical models and/or demonstrative exhibits for the purpose of further evaluating, illustrating and explaining how the subject Chart Tank is intended to operate and the manner in which it failed.

### **Qualifications**

I hold a B.S.E., M.S. and Ph.D. in Mechanical Engineering and Materials Science with a minor in Computer Science. I have over 34 years of experience as a forensic engineer having worked in the areas of failure analysis, materials science, product liability, accident reconstruction, computer aided engineering, modeling, simulation, and visualization. A copy of my curriculum vitae is attached as Appendix A.

### **Compensation**

My firm currently charges \$445 per hour for my time plus expenses. Deposition and trial related time is billed at \$495 per hour.



\_\_\_\_\_  
Anand David Kasbekar, Ph.D.

10/15/2019  
Date

\_\_\_\_\_  
<sup>44</sup> Deposition of Alden Romney 103:13-14

## **Appendix A**

### **Kasbekar Curriculum Vitae**

## **Anand David Kasbekar, Ph.D.**

### **Education**

|        |   |
|--------|---|
| B.S.E. | Mechanical Engineering, Duke University 1985  |
| M.S.   | Mechanical Engineering and Material Science, Duke University 1987                                     |
| Ph.D.  | Mechanical Engineering and Material Science with a<br>Minor in Computer Science, Duke University 1994 |

### **Qualifications**

Dr. Kasbekar's area of expertise is in the field of Mechanical Engineering and Materials Science with an emphasis on accident investigation, failure analysis, safe product design, computer simulation and 3D-visualization. His graduate research concentrated on the development of a nondestructive materials characterization technique which can be used to analyze defects in both metals and polymers at sub-microscopic levels. Dr. Kasbekar's research was funded by the Army Research Office. As part of this research, Dr. Kasbekar implemented a computer controlled system for thermal control and automated data collection. He has also conducted research involving low angle X-ray diffraction, thermal analysis, and mechanical testing to evaluate both metallic and polymeric components.

As a consultant with Research Engineers, Inc. (REI) since 1987, Dr. Kasbekar has worked in the areas of forensic engineering, materials characterization, product liability, and failure analysis. Currently, Dr. Kasbekar serves as President of Visual Sciences, Inc. (VSI) and has over 30 years of experience in the application of computer simulation and scientific visualization to the field of forensic engineering. This experience includes 3-dimensional computer modeling, photogrammetry, computer-aided accident reconstruction, computer imaging, finite element analysis and simulation of dynamic systems. Dr. Kasbekar has applied his computer expertise to the areas of accident reconstruction, failure analysis, safe product design, and human factors studies.

In addition to his work with VSI and REI, Dr. Kasbekar has served as an Adjunct Assistant Professor in the Department of Mechanical Engineering and Materials Science at The Duke University School of Engineering since 1995. He has also served on the executive committee and as President of the Duke University Engineering Alumni Council. He has served on the governing board for the Society of Automotive Engineers as the Vice-Chair of Math & Science for the North Carolina Section. Dr. Kasbekar has been the Principal Investigator and Research Scientist for multiple research and development contracts that have been awarded to Visual Sciences, Inc. by the United States Department of Defense.

## **Relevant Experience and Post Graduate Training**

- Failure Analysis of Metals and Plastics
- Finite Element Modeling and Analysis
- Accident Reconstruction
- Photogrammetry
- Defect and Failure Analysis of Automotive Components
- Machine Guarding and Safe Product Design
- Materials Characterization and Testing
- Computer Simulation and Animation
- Perceptual Discrepancies in Color Production
- State-of-the-Art Data Visualization
- Physically Based Modeling
- Particle System Modeling
- Computer Graphics in Visual Effects
- Procedural Modeling and Rendering Techniques
- Recent Techniques in Human Modeling, Animation and Rendering
- Anthropometry and Laser Scanning of Humans
- UNIX, IRIX, VMS, DOS, Windows, and Macintosh Operating Systems
- The Effect of Impact and Other Rapid Loading Mechanisms on Plastics
- Polymer Degradation, Stabilization, and Failure Analysis
- Plastic Component Failure Analysis
- Failure Analysis of Plastic and Rubber Materials
- Environmental Stress Cracking and Other Solvent Effects
- Properties and Failure Mechanisms of Polycarbonate
- Preventing Plastic-Product Failures
- Advance Polymer Testing DEA
- Polymer Analysis from Raw Material to Formulation
- 3D Metrology in QA and Reverse Engineering
- 3D Laser Scanning for Boatbuilding

## Professional Experience

*Principal:* Visual Sciences, Inc., Raleigh, NC (1995-Present): Directs all aspects of the Computer Visualization Laboratory. Specializing in the application of computer visualization and simulation to solve problems in the fields of science and engineering.

*Consultant:* Research Engineers, Inc., Raleigh, NC (1987-Present): Works as a forensic engineer in the areas of accident reconstruction, failure analysis, safe product design, and human factors studies. Developed and directed the Computer Visualization Laboratory for Research Engineers.

*Assistant Adjunct Professor:* Duke University School of Engineering, Department of Mechanical Engineering and Materials Science, Durham, NC (1995): Responsibilities included research, teaching, laboratory work, application of computer simulation and visualization technology to failure analysis case studies.

*Contract Research Consultant:* Battelle Memorial Institute, Columbus, OH (1993): Developed computer simulation model to analyze dynamic failure modes of proprietary thermal cut-off devices for electrical components.

*System Administrator:* Department of Mechanical Engineering and Materials Science, Duke University (1986-1987): Hardware and software management for DEC MicroVax II, Macintosh and DOS based computers; systems integration; and development of data acquisition and analysis programs.

*Engineer:* MPR Associates, Washington, D.C. (1986): Developed course in metallurgy and failure analysis for engineers; conducted failure analysis and defect analysis of metallic components primarily for naval and power generation equipment.

*Research and Teaching Assistant:* Department of Mechanical Engineering and Materials Science, Duke University (1984-1986). Conducted research in the area of materials science, failure analysis, and polymer characterization; laboratory instructor and teaching assistant for Failure Analysis and Materials Science classes.

*Engineering Assistant:* Federal Emergency Management Testing Facility, Naval Yard, Washington, D.C. (1983). Designed, prototyped, fabricated and tested equipment to manufacture and evaluate cumulative radiation dosimeters.

*Supervisor:* Department of Transportation, Duke University (1982-1986). Responsibilities included driver training, supervision, and scheduling of transportation personnel; basic fleet maintenance and repair scheduling.

## **Professional Societies**

American Society of Mechanical Engineers  
ASM The Materials Information Society  
American Society of Safety Engineers  
Society of Automotive Engineers  
Association for Computing Machinery  
Society of Plastics Engineers  
National Society of Professional Engineers (Past Member)  
National Computer Graphics Association (Past Member)  
The Metallurgy Society (Past Member)  
National Safety Council (Past Member)

## **Honors**

Dean's List 4 years  
Class Honors 4 years  
Pi Tau Sigma International Mechanical Engineering Honor Society  
Tau Beta Pi Engineering Honor Society  
Graduated Magna Cum Laude  
Graduated with Departmental Distinction  
Research and Teaching Award for Graduate Study  
Awarded Plastics Institute of America Fellowship

## **Major Research Awards, Seminars, and Publications**

“Modeling Integrated Helmets for Aviation”, Research Contract, US Department of Defense, 2003.

“Pressure Sensing Headforms”, Research Contract, US Department of Defense, 2000.

“A Dynamic Model for Design Optimization of Protective Masks”, Research Contract, US Department of Defense, 1997.

“High Technology and Construction: Tools for the Millennium  
Forensic Applications of Three-Dimensional Computer Simulation & Visualization.”  
North Carolina Bar Association, Durham, NC 1998 (Invited Speaker).

“The Use of Computer Simulation and Visualization as a Forensic Engineering Tool”,  
The Americans Inns of Court, Duke University School of Law, Durham, NC 1996  
(Invited Speaker).

"The Application of 3-dimensional Computer Simulation & Visualization to the Fields of  
Accident Reconstruction and Forensic Engineering." Tennessee Defense Lawyers  
Association, Nashville, TN, 1995 (Invited Speaker).

"Seeing is Believing: Winning Your Case Through the Use of Computer Simulation." Stark County Academy of Trial Lawyers Fall Seminar, Akron, OH, 1994 (Invited Speaker).

"Computer Simulation and Visualization as an Engineering Tool." Joint Meeting of the North Carolina Chapter of the Society of Automotive Engineers and American Society of Mechanical Engineers, Raleigh, NC, 1994 (Invited Speaker).

"Fundamentals of 3D Computer Animation." Alliance Training Consortium, Raleigh, NC, 1993 (Instructor).

"State-of-the-Art in Accident Reconstruction and Computer Aided Simulation/Animation." West Virginia Trial Lawyers Mid-Winter Seminar, Charleston, WV, 1991 (Invited Speaker).

"Computer Simulation and Visualization." Panel on Multimedia, MacWorld Exposition, Boston, MA, 1989 (Invited Speaker).

Kasbekar, A.D. "A Positron Annihilation Lifetime Study of The Effects of Molecular Weight On Thermal Response and Free Volume Relaxation in Polystyrene." M.S. Thesis, Duke University Department of Mechanical Engineering and Materials Science, Durham, NC, 1987.

Kasbekar, A.D., P.J. Jones, and A. Crowson. "Positron Annihilation Lifetime Evaluation of Thermal Cycling Effects in Atactic Polystyrene." Journal of Polymer Science: Part A: Polymer Chemistry, 27 (1989): 1373-1382.

Kasbekar, A.D., P.J. Jones, and A. Crowson. "A Positron Annihilation Lifetime Study of Thermal Response and Isothermal Relaxation in Atactic Polystyrene." 8th International Conference On Positron Annihilation. Ed. L. Dorikens-Vanpraet, M. Dorikens and D. Segers. Gent Belgium: World Scientific, 1988.

Kasbekar, A.D. "A Positron Annihilation Lifetime Study of Crosslinked Polystyrenes and Sequential Polystyrene/Polystyrene Interpenetrating Polymer Networks." Ph.D. Dissertation, Duke University Department of Mechanical Engineering and Materials Science, Durham, NC, 1994.

| <b>Testimony of<br/>Anand David Kasbekar, Ph.D.</b> |   |  |
|---|---|--|
| January 13, 2014                                    | Fairlawn<br>Enterprices, LLC v<br>IES Commercial<br>Inc. a Newcomb<br>Electric                              | Commonwealth of Virginia In the Circuit Court of the<br>City of Roanoke                                |
| February 6, 2014                                    | Bruce v CAV<br>International, et al   | In the Circuit Court of Cook County, Illinois  |
| February 11, 2014                                   | Linda Taylor,<br>Phillip Taylor and<br>Elizabeth Van Pelt<br>Vs Sportsman's<br>Outfitters &<br>Marine, Inc. | In the Circuit Court of Macon County State of Missouri   |
| February 18, 2014                                   | Daniel Dobson, et<br>al. vs Renee Wade,<br>et a.  | In the Circuit Court of the 19 <sup>th</sup> Judicial Circuit, in and<br>for St. Lucie County, Florida |
| March 11, 2014                                      | Townsend v<br>NCDOT   | North Carolina Industrial Commission   |
| May 15, 2014  | Dorman vs Atmos<br>Energy   | In the Circuit Court of the City of Richmond   |
| July 29, 2014                                       | Miller vs Richard<br>Allen Gaddy, Blue<br>Max Trucking, et al   | State of North Carolina County of Mecklenberg  |
| August 21, 2014                                     | Bruno Vono vs<br>Paul H. Angier and<br>John K. Wolfe  | In the Circuit Court of the Seventeenth Judicial Circuit<br>in and for Broward County, FL              |
| August 29, 2014                                     | Dorman vs Atmos<br>Energy   | In the Circuit Court of the City of Richmond   |
| September 9, 2014                                   | Townsend v<br>NCDOT   | North Carolina Industrial Commission   |
| September 12, 2014                                  | Townsend v<br>NCDOT   | North Carolina Industrial Commission   |
| September 25, 2014                                  | Vollman Nicholas<br>vs Middlesex<br>Corporation   | In the Circuit Court of the Ninth Judicial Circuit, in and<br>for Orange County, FL                    |
| October 24, 2014                                    | Bruno Vono vs<br>Paul H. Angier and<br>John K. Wolfe  | In the Circuit Court of the Seventeenth Judicial Circuit<br>in and for Broward County, FL              |

|                   |   |  |
|-------------------|---|--|
| October 29, 2014  | Bruno Vono vs Paul H. Angier and John K. Wolfe  | In the Circuit Court of the Seventeenth Judicial Circuit in and for Broward County, FL   |
| May 20, 2015      | Lois Huffman et al. vs City of Marion, OH   | In the Court of Common Pleas of Marion County, OH  |
| June 9, 2015      | Debra Jane PIPPS, et al vs Robert O'Neal McCants, et al.                                      | State of South Carolina Court of Common Pleas County of Horry Fifteenth Judicial Circuit |
| June 15, 2015     | Micron Technology v Safway Services, Inc. and Robert Aquino                                   | Virginia - In the Circuit Court for the City of Alexandria                               |
| August 7, 2015    | Kawasaki Motors Manufacturing, et al. vs ITW Fastex-CVA, et al.                               | In the Circuit Court of Jackson County, Missouri at Independence                         |
| August 21, 2015   | The Estate of Peter Paul Faust, et al. vs Strata Corporation, et al.                          | In the United States District Court for the District of Montana Billings Division        |
| November 17, 2015 | Hickerson vs Yamaha Motor Corp., et al.   | United States District Court District of South Carolina Anderson Division                |
| February 2, 2016  | Quentin Ravizza vs PACCAR, Inc & Kenworth Truck, Co.  | In the United States District Court Northern District of Illinois Eastern Division       |
| February 5, 2016  | Tracy Sanborn and Louis Lucrezia vs Nissan North America, Inc.                                | United States District Court Southern District of Florida                                |
| February 25, 2016 | Lesley Marbeth Derrick, deceased vs. Berlin G. Myers Lumber Corp., and Daniel Patrick Siebert | In the Court of Common Pleas for the State of South Carolina Dorchester County           |

|                   |   |  |
|-------------------|---|--|
| March 3, 2016     | H.J. Heinz Company vs. Atlantic Aviation FBO Holdings, LLC and Mercury Air Center – Nashville, LLC<br><br>Global Aerospace, Inc., vs. Atlantic Aviation FBO Holdings, LLC and Mercury Air Center – Nashville, LLC | In the Circuit Court for Davidson, Tennessee at Nashville  |
| May 3, 2016       | Carolyn Thomson and Aaron Hoylk vs. Spokane County, a municipal corp, Spokane County Sheriff’s Dept., and Joseph Bodman   | In the Superior Court of the State of Washington in and for the County of Spokane                |
| April 26, 2017    | Melinda S. Spratt, Plaintiff vs. TREK Bicycle Corporation, Defendant  | In the Superior Court of Cobb County State of Georgia  |
| May 17, 2017      | Barlow vs The Cook Group, Galleon Resort at Key West  | In the Circuit Court of the Eleventh Judicial Circuit in and for Miami-Dade County, Florida      |
| June 6, 2017      | Quentin Ravizza vs PACCAR, Inc & Kenworth Truck, Co.  | In the United States District Court Northern District of Illinois Eastern Division               |
| June 19, 2017     | Quentin Ravizza vs PACCAR, Inc & Kenworth Truck, Co.  | In the United States District Court Northern District of Illinois Eastern Division               |
| August 29, 2017   | Billy Jo Humphries v. JLG Industries, Inc.  | In the United States District Court For The Eastern District of Virginia                         |
| November 20, 2017 | Whynot vs Publix  | In the Circuit Court of the Ninth Judicial Circuit in and for Orange County, Florida Division 35 |
| January 25, 2018  | Tribble vs Warwood Tool Company   | In the United States District Court for the Western District of Virginia Lynchburg Division      |

|                   |  |   |
|-------------------|--|---|
| April 27, 2018    | Rider vs Kawasaki Motors, Corp   | In the United States District Court District of Utah, Central Division                    |
| July 31, 2018     | Bennie Wood and Linda Wood vs Navistar, et al.                               | In the Circuit Court of Cook County, Illinois County Department, Law Division             |
| November 2, 2018  | Laura Frances Hays vs Nissan North America Inc., Nissan Motors Company, LTD. | In the United States District Court for the Western District of Missouri Western Division |
| November 13, 2018 | Bennie Wood and Linda Wood vs Navistar, et al.                               | In the Circuit Court of Cook County, Illinois County Department, Law Division             |
| December 14, 2018 | Rider vs Kawasaki Motors, Corp   | In the United States District Court District of Utah, Central Division                    |